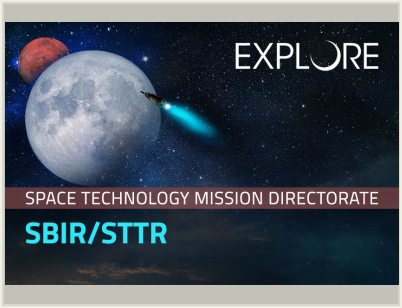
Generation and Adaptive Modification of Anisotropic Meshes, Phase II

Completed Technology Project (2011 - 2013)

Project Introduction

The ability to quickly and reliably simulate high-speed flows over a wide range of geometrically complex configurations is critical to many of NASA's missions. Advances in CFD methods and parallel computing have provided NASA the core flow solvers to perform these simulations. However, the ease of use of these flow solvers and the reliability of the results obtained are a strong function of the technologies used to discretize the domain. Many applications involve solutions with highly anisotropic features: boundary layers, shear layers, wakes, shocks etc. Efficient resolution of those features motivates matching the mesh resolution/anisotropy to the solution's anisotropy but, in the more challenging applications, the location and strength of those features is difficult to precisely estimate prior to solution. Currently available meshing tools are not capable of producing and controlling the required initial meshes, nor adapting the mesh to match evolving anisotropic features. This project will combine Simmetrix Inc. expertise in the development of meshing components for flow simulations, and Rensselaer's Scientific Computation Research Center expertise in the development of adaptive mesh control technologies, to provide NASA the mesh generation and adaptation technologies needed. New techniques will be developed to create highly anisotropic semi-structured and unstructured meshes suitable for CFD simulations with high Reynolds number flow features (e.g., boundary layers, bow shocks, free shear layers, wakes, contact surfaces). Techniques to adapt these meshes based on mesh correction indicators will be developed to enable fully automated adaptive simulations. All procedures to be developed will work effectively in parallel on large-scale parallel computers and will support a wide range of flow solvers. The overall capabilities will be demonstrated through execution of fully automated parallel adaptive simulations on problems relevant to NASA.



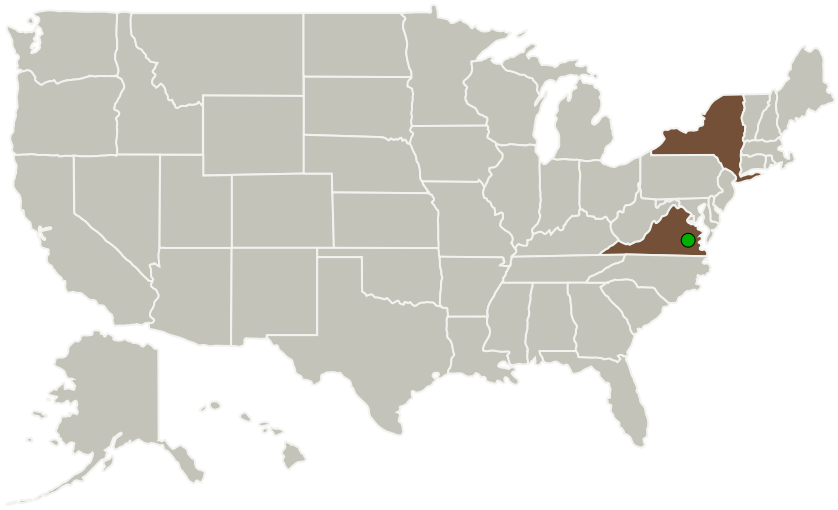
Generation and Adaptive Modification of Anisotropic Meshes, Phase II

Table of Contents

Generation and Adaptive Modification of Anisotropic Meshes, Phase II

Completed Technology Project (2011 - 2013)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Simmetrix, Inc.	Lead Organization	Industry	Clifton Park, New York
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
Rensselaer Polytechnic Institute	Supporting Organization	Academia	Troy, New York

Primary U.S. Work Locations	
New York	Virginia

Project Transitions

July 2011: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Simmetrix, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

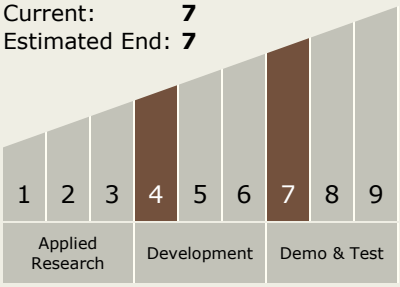
Carlos Torrez

Principal Investigator:

Saurabh Tendulkar

Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **7**



Generation and Adaptive Modification of Anisotropic Meshes, Phase II

Completed Technology Project (2011 - 2013)

June 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138891)*

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System